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DECISION MAKING IN A DYNAMIC TASK ENVIRONMENT: THE EFFECT OF TIME PRESSURE

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SUMMARY

Two experiments were conducted to investigate time pressure effects on both the selected decision strategy and the quality of task performance. A dynamic task environment was used. Subjects were required to monitor the continuously changing fitness level of an athlete, and to recover the athlete whenever fitness decline had a physiological cause. Time pressure was defined by the rate at which the fitness level changed over time. The major decision problem of the subjects was to trade-off the costs of requesting information against the increasing risk of a costly consequence. The experiments differed in the incentive scheme that was used: in the first experiment, the subjects increased their chance on a bonus by saving time, whereas in the second experiment they could directly save on money. Both experiments showed a speed-up of information processing as time pressure increased. In the first experiment subjects started to request information at the same fitness levels in all time pressure conditions, whereas in second experiment subjects started to request information at higher fitness levels when time pressure increased. However, in both experiments performance equally deteriorated under time pressure, as indicated by the number of athlete collapses. It is concluded that even though the subjects changed their strategy and increased their speed of information processing under time pressure, performance declined more than predicted by time constraints alone. This extra effect is ascribed to the characteristics of the task environment.

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Beslissen in een dynamische taakomgeving: het effect van tijdsdruk

J.H. Kerstholt

SAMENVATTING

In twee experimenten werd het effect van tijdsdruk onderzocht op zowel de beslisstrategie als de uiteindelijke prestaties. Er werd een dynamische taakomgeving gebruikt. De proefpersonen zagen via een grafiek het steeds veranderende conditieniveau van een atleet, en moesten een actie uitvoeren indien een daling van het conditieniveau werd veroorzaakt door een fysiologisch probleem. Tijdsdruk werd gedefinieerd door de snelheid waarmee het conditieniveau daalde. De proefpersonen moesten met name de kosten van informatie afwegen tegen het toenemende risico op een duur gevolg. De twee experimenten verschilden in het gehanteerde beloningssysteem: in het eerste experiment hadden de proefpersonen een kans op een bonus door het besparen van tijd en in het tweede experiment konden de proefpersonen direct geld besparen. Uit de resultaten van beide experimenten bleek dat onder tijdsdruk informatie sneller werd verwerkt. Het moment waarop de proefpersonen begonnen met het opvragen van informatie veranderde in het eerste experiment niet onder tijdsdruk maar in het tweede experiment wel. Uit beide experimenten bleek echter dat de prestaties significant slechter werden onder tijdsdruk, hetgeen werd uitgedrukt door het percentage atleten dat "stuk" liep. Op basis van deze resultaten werd geconcludeerd dat ondanks het feit dat de proefpersonen hun strategie aanpasten en informatie sneller verwerkten onder tijdsdruk de prestaties slechter waren dan op basis van tijdsbeperkingen alleen kan worden voorspeld. Deze extra vermindering werd toegeschreven aan de karakteristieken van de taakomgeving.

1 INTRODUCTION

Only limited attention has been directed towards judgement and decision making processes in dynamic task environments (Hogarth, 1981; Hammond, 1988; Kleinmuntz & Thomas, 1987). A dynamic task is characterized by an environment that changes over time both autonomously and as a result of actions taken by the decision maker. Compared to static situations a different range of strategies becomes available, especially those that take advantage of the feedback provided by the environment (Hogarth, 1981). In general, three strategies can be distinguished which can be used by the decision maker at each point in time: acting, gathering more information or waiting. Thus, to take an example from a medical environment, a physician can apply a treatment, she can send the patient to a hospital for some additional tests or she can decide to wait and to monitor the development of the disease over time.

The present studies investigated whether the selected strategy would depend on the time pressure imposed on the decision maker. In a dynamic task environment time-pressure can be defined internally: the speed at which the system develops towards some negative consequence. If the risks of some serious consequence are rapidly increasing, less time is available for information gathering. A well-known example which illustrates such a decision problem is the "Vincennes-incident": in 1988 the US Navy ship "Vincennes" detected an approaching aircraft, which could not easily be identified as either a military or a civil aircraft. The commander had to decide after some minutes whether to act or to wait. Waiting would have provided more information on the exact identification of the aircraft but would also have increased rapidly the potential risks for own safety. The commander did not take this risk but shot down the aircraft, which was in retrospect the wrong action.

Previous research has exclusively used time-pressure in an external way, i.e. by posing deadlines. The results from this line of research show that under time pressure:

- Speed of information processing is increased (Ben Zur & Breznitz, 1981; Maule & Mackie, 1990; Payne, Bettman & Johnson, 1988).
- More noncompensatory strategies are used (Payne, Bettman & Johnson, 1988; Svenson, Edland & Slovic, 1990; Zakay, 1985).
- Less risks are taken (Ben Zur & Breznitz, 1981).
- A greater weight is placed on negative evidence (Ben Zur & Breznitz, 1981; Wright, 1974).

Furthermore, changing the information processing strategies also affects the decision outcome (Svenson & Edland, 1987; Zakay & Wooler, 1984). Yet, even though performance declines with regard to some normative solution, recent theoretical frameworks focus on the adaptive aspects of strategy selection (Christensen-Szalanski, 1980; Smith, Mitchell & Beach, 1982; Payne, Bettman & Johnson, 1988). Payne, Bettman and Johnson (1988) for example simulated the

employment of several strategies under time limits and registered the accuracy of the outcome and the invested effort. The strategies that were selected by subjects in an experimental task were compared to these outcomes, showing that they adaptively reacted to a time-pressured environment by efficiently incorporating choice accuracy and required effort in the decision making process. Therefore even though accuracy decreases under time pressure, the available resources may be employed optimally, resulting in efficient task performance.

Compared to these conclusions, research on decision making in dynamic task environments has revealed a more pessimistic picture. In a dynamic environment subjects misjudge feedback (Brehmer, 1987; Sterman, 1989), they ignore time related aspects (Dörner, 1980) and use sub-optimal strategies (Hogarth & Makridakis, 1981; Kleinmuntz & Thomas, 1987). However, in most of these studies rather complex tasks were used, making knowledge aspects confounded with decisional aspects. Especially the recognition of patterns in the surface behaviour of a system is a typical form of expert knowledge (Glaser, 1986). The goal of the present experiment was to address the strategic components of decision making only and to avoid possible confounding effects of knowledge on task performance.

Thus, of primary interest to the present studies was the influence of internally defined time pressure on strategy selection. The task environment had to allow for an unambiguous interpretation of both feedback from the system and the requested information. The following paragraph gives a general description of the present task and elaborates on the different strategies that might be used.

Subjects were required to control the continually changing fitness level of an athlete, which was graphically presented to them on a computer screen. In reality the fitness level should have been inferred from a number of cues, but in order to avoid interpretation differences due to cue integration processes, the subject was provided with the overall value of the state of the athlete. In most natural decision contexts people do not have knowledge of the exact probability distribution of uncertain events, or in other words the environment is ambiguous (Einhorn & Hogarth, 1986). In order to simulate this aspect, the declines in the athlete's condition had either a physiological cause or were random fluctuations from which the athlete would recover spontaneously. The subjects are not informed on the ratio of these events (which in fact was 1:2). The underlying cause of the decline can be accessed by requesting information on three physiological parameters. Through this information the behaviour of the system can be evaluated and a corresponding action, if necessary, can be carried out. When the graph reaches a bottom-line (fitness level 0) the athlete is out of the race. Time pressure is defined by the rate at which the athlete's condition declines. In the first experiment costs of information, action, dosage and athlete collapse are defined by time. Whenever information is requested or a treatment is applied the athlete is out of the race. In the first experiment the subjects are encouraged to use time economically by providing a bonus for the most efficient subject. If

the athlete collapses extra time is lost, essentially implying that the chance on the bonus is gone. Thus, subjects primarily have to make a trade-off between the costs of information versus an increasing likelihood of a costly consequence.

In light of this task several strategies can be defined that differentially weight the costs of information and the chance on athlete collapse. To illustrate such strategic effects for different levels of time pressure we have calculated the expected time spent on information and the chance on athlete collapse for two (extreme) strategies. Figure 1 shows the chances positive or negative information after each information request when the decline is either "physiological" or "natural".

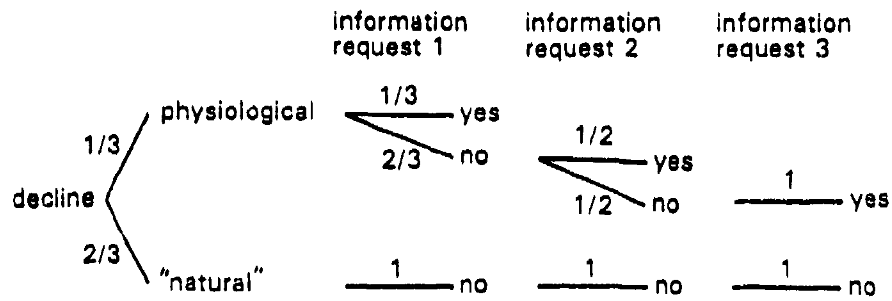

Fig. 1 Chances on positive and negative information after each information request when the decline is either "physiological" or "natural".

Based on a pilot experiment we assumed that 10 seconds are needed to carry out an action and 5 seconds to retrieve one information unit. Furthermore, the fitness level declines linearly with slopes of respectively -0.5, -1.0 and -2.0 (low, moderate and high time pressure) and all "natural" declines will have been recovered for sure at a fitness level of 25.

The first strategy minimizes the probability of athlete collapse by requesting information at a fitness level of 75, 50 and 25 in each time pressure condition. When this strategy is employed 13.3 seconds [(1/9*15) + (1/9*20) + (1/9*25) + (2/3*10)] are expected to be spent on athlete recovery in each trial, with a probability of zero of athlete collapse. The second strategy minimizes the costs of information by requesting no information during a "natural" decline: i.e. the subjects wait until a fitness level of 25 before they start to request information. Obviously, as compared with the first strategy the expected time lost on information requests is reduced (6.7 seconds) because no information is requested during a natural decline. In the moderate time pressure condition subjects will not have enough time to recover the athlete when three information requests have to be made, meaning that there is a chance of 1/9 on athlete collapse. In the high time pressure condition the remaining time is too short (12.5 seconds) to request one information unit and to apply a treatment (15 seconds), implying

a chance of 1/3 on athlete collapse. Thus, the first strategy implies high information costs but no athlete collapse and the second strategy implies low information costs but a high chance on athlete collapse when time pressure increases. The differential results of both strategies for the three time pressure conditions suggest that an adaptive response to time pressure would be to wait under low time pressure in order to reduce information costs, but to request information at higher fitness levels under high time pressure in order to reduce the chance on athlete collapse. On the assumption that subjects adaptively react to time pressure we therefore predict an effect of time pressure on the fitness level at which subjects start to request information.

In defining these strategies we assumed a fixed information processing time, i.e. the time needed to apply a treatment after the underlying cause of the decline is known. However, in line with previous findings from static task paradigms subjects may increase their speed of information when time pressure increases. The second prediction is therefore that speed of information processing increases under time pressure.

2 EXPERIMENT 1

2.1 Method

Subjects

Twenty students of the University of Utrecht participated in the experiment. They were paid Dfl. 40 for their participation.

Stimulus material

A computer program graphically depicts the fitness of an imaginary athlete who is running a race. The fitness value can vary between 100 (optimal fitness) and 0 (the athlete collapses) with the addition of some random noise (mean = 0, s = 6.5). Figure 2 gives an example of a computer screen depicting the athlete's fitness level in one of its windows.

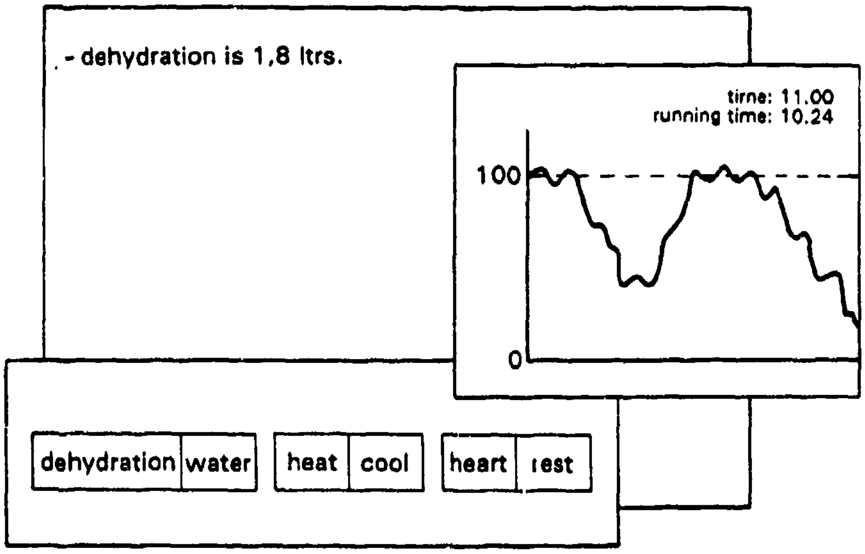

Fig. 2 Example of a computer screen showing the graphical representation of the athlete's fitness level, choice options for information and treatments, and requested information.

Four reasons may cause the athlete's fitness to deteriorate: three "physiological" causes, which are dehydration, overheating and cardiac overload, and one unknown "natural" cause from which the athlete will recover spontaneously. A decline of the fitness level at a certain point in time is defined by a linear function. Therefore, without intervention of the subject the athlete will collapse as a result of the on-set of some physiological disturbance. In each trial the slope, indicating the deterioration of the fitness level per second, remains constant. Over trials however the slope may differ, defining the time pressure condition (see Fig. 3 for an illustration).

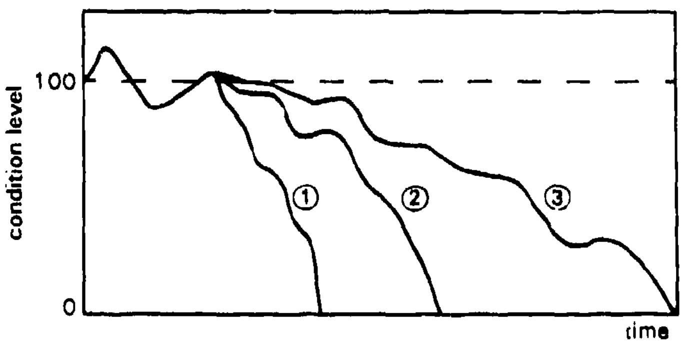

Fig. 3 Illustration of condition decline in three time pressure conditions: 1: slope = -2, 2: slope = -1, 3: slope = -0.5.

The subject sees only one function depicting the fitness level of the athlete over time. The fitness function is constructed from the four separate functions that specify the fitness declines for each parameter in time.

If a decline is of a physiological nature, the subject can recover the athlete by giving the appropriate treatment, i.e. water for dehydration, rest for cardiac overload and cooling for overheating. If the appropriate treatment is applied the athlete's condition will restore and the trial ends. If not, the athlete will collapse and the trial ends as well.

Procedure

The subject is instructed to monitor the fitness of an athlete who is running a race and to avoid the athlete to collapse (i.e. to reach a fitness level of zero). To attain this goal the subject can request information and apply treatments. All commands are menu-driven and served by mouse-clicks.

Information can be requested on the state of the athlete's dehydration, her temperature or her heart rate. After the nature of the information is selected the subjects are prompted whether subjective information or objective information is required. Subjective information is a response of the athlete indicating whether she is thirsty, warm or has an accelerated heart rate. The athlete will give this response whenever her fitness level declines below a mean fitness level of 60 ($s = 6.5$). The objective information type gives the exact value of the physiological parameter. In selecting one of these information types subjects have to make trade-offs between the reliability of information and the time to get the information (delays of 2 and 4 seconds respectively). The athlete is out of the race during retrieval of this information.

In addition, subjects can apply the following treatments: give water, rest or cool. Only one treatment is suitable for each possible physiological state; water for dehydration, rest for cardiac overload and cooling for overheating. After a treatment is selected the subjects are prompted to specify the time period the athlete should rest or cool or the amount of water that has to be given to the athlete. They know that the maximal amount of water is 8 litres and the maximal time for cooling and resting is 50 seconds. They are instructed to restore the athlete to a fitness level of 100. A discrepancy will cost them extra time. Whenever a treatment is applied the athlete is out of the race.

In order to encourage the subjects to stop the athlete for the shortest possible time we informed them that a bonus (Dfl. 50) would be given to the subject with the most efficient task performance (least time lost on information requests, treatments, athlete collapses and incorrect dosage).

Subjects start with a training session (3 trials in each time pressure condition) that allows them to get acquainted with the physical task environment and to develop strategies to cope with time pressure. Both the training session and the experimental session lasted approximately two hours.

Design

There are three time pressure conditions which are defined by the function-slopes: low time pressure (a = -0.5), moderate time pressure (a=-1), and high time pressure (a = -2). Each subject supervised four athlete's (trials) in each time pressure condition. A new trial would start when an athlete either had collapsed or was given an appropriate treatment. In each time pressure condition 8 dummy trials were included which were randomly divided over trials. Dummy trials were "natural" declines from which the athlete would recover spontaneously. The mean fitness level at which the function would turn back was 47.9 (s = 11.4).

2.2 Results

As argued in the introduction we predicted that subjects would start to request information at higher fitness levels when time pressure increased. However, this prediction was not supported by the results (see Fig. 4).

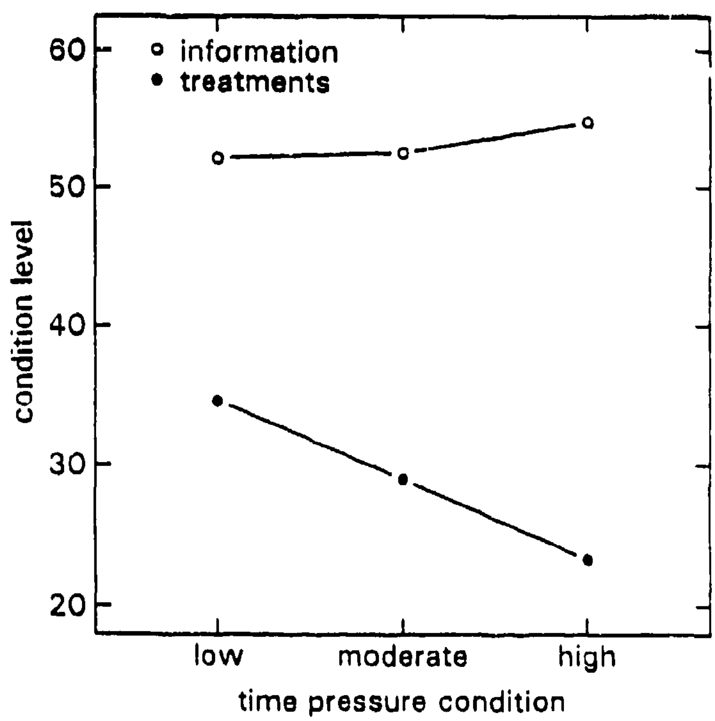

Fig. 4 Mean fitness level at which the subjects requested information and applied a treatment for each time pressure condition.

The fitness level at which an information request was made for the first time after the onset of a decline was the same for each time pressure condition [$F(2,38) < 1$]. The obvious consequence of this fixed criterion is that the fitness level at which treatments were applied declined significantly over time pressure conditions [$F(2,38) = 8.73$; $p < 0.001$].

We also predicted that subjects would increase their speed of information processing. An indication of processing speed is the difference between the moment the subjects received information on the underlying cause of the decline and the moment they applied a treatment. Information processing speeded up significantly over time pressure conditions [$F(2,38) = 7.59$; $p < 0.005$, see Table II]. In this time span subjects deduced the underlying cause of the decline in fitness level, selected a treatment and calculated its dosage. Since a deviation of one parameter directly indicated the underlying cause of the decline and only one treatment corresponded to a particular deviation these actions are not expected to be affected by processing time reductions. In fact, computation time will primarily have been spent on the calculation of the treatment dosage. To indicate such an effect we calculated the relative deviation of the applied dosage from the optimal dosage (see Table I)

$$\text{abs}\ \frac{\text{optimal dosage} - \text{applied dosage}}{\text{optimal dosage}}\ .$$

These values did not differ significantly over time pressure conditions, implying that performance not deteriorated as a result of the reduced processing time.

Table I Mean times (in seconds) that subjects needed to apply a treatment after the relevant information had appeared on the screen and treatment dosage for each time pressure condition.

time pressure	low	moderate	high
mean treatment decision time	12.69	10.98	7.83
treatment dosage	0.36	0.26	0.28

Another possibility to save time is to use subjective rather than objective information under time pressure. After the subjects had indicated on which physiological parameter they wanted to be informed, they were prompted to specify which type of information was required: subjective or objective information. These information types differed in reliability and retrieval time. Subjects mostly preferred subjective information. However, the proportions of this type of information did not vary across time pressure conditions [low time pressure: 0.66, moderate time pressure: 0.65, high time pressure: 0.72, $F(2,38) = 2.2$; $p > 0.1$].

As far as the performance scores are concerned the results show that more athletes collapsed when time pressure increased [$F(2,38)=5.09$; $p<0.01$, see Table II]. These trials were analyzed more closely in order to retrace the main reasons for athlete collapse. In most of the trials the subjects were still requesting information when a collapse occurred, suggesting that they started too late with their information requests (see Table II). One collapse in the low time pressure condition was caused by an incorrect treatment. All other collapses were caused because subjects had requested subjective information at high fitness levels. Note however that subjective information would only be diagnostic after the fitness level had declined below a mean value of 60 ($s = 6.5$), meaning that these subjects were not correctly informed on the underlying cause.

Table II Proportion trials correctly dealt with, proportion athlete collapses that were caused by reacting too late to fitness declines and proportion athlete collapses resulting from incorrect (subjective) information.

time pressure	low	moderate	high
proportion trials	0.95	0.88	0.78
too late	0.67	0.90	0.65
subjective information	0.00	0.10	0.35

2.3 Discussion

The present experiment partly replicates the results found within static task environments such that subjects adaptively reacted to time pressure by increasing speed of information processing. However, we also predicted that subjects would switch to another strategy under time pressure: i.e. request information at higher fitness levels. This prediction was not supported by the results. Subjects started to request information at the same fitness level in all time pressure conditions, which implies that more risks were taken under high time pressure. The detrimental effect of this strategy is indicated by the increased number of athlete collapses under time pressure. Therefore, at first sight the results suggest that subjects are less adaptive under time pressure in dynamic task environments than suggested by studies using static tasks.

However, judging the adaptivity of subject behaviour requires that one knows what exactly they are trying to optimize (Anderson, 1990). In the present task a bonus was given to the subject with the most efficient performance, i.e. the one who "lost" the least amount of time. Even though athlete collapses minimized the chance on the bonus, most time could be saved by not requesting information

during "natural" declines. This may well have motivated the subjects to take some risks, i.e. reacting late to declines reduces the amount of information requests during "natural" declines and consequently reduces information costs. In order to test for this "bonus-effect" we have conducted a second experiment in which a different incentive scheme was used. In this experiment costs were expressed by (real) money, rather than by time. With such an incentive-scheme the trade-off between information costs and chance on athlete collapse is more direct, providing a better test for adaptive strategy selection.

3 EXPERIMENT 2

3.1 Method

Subjects

Twenty subjects of the University of Utrecht participated in the experiment. Their earnings depended on their task performance with a minimum of Dfl. 20 and a maximum of Dfl. 45.

Procedure (incentive scheme)

Exactly the same task was used as in the first experiment, with the exception of the incentive scheme. In the previous experiment subjects could increase their chance on a bonus by saving time. In the present experiment however, the subjects could directly save on money. They started with an amount of Dfl. 30. Each time an athlete collapsed they paid Dfl. 5, for subjective information they paid Dfl. 0.25 and for objective information Dfl. 0.50. Each time a correct action was chosen they received Dfl. 2.50. As in the previous experiment they had to recover the athlete to a fitness level of 100. They had to pay Dfl. 0.25 for each 10% departure from a recovery level of 100.

3.2 Results

Again we predicted that subjects would adapt to time pressure by selecting a different strategy (start to request information at higher fitness levels) and by increasing speed of information processing. Both predictions were supported by the results. Subjects started to request information at higher fitness levels under increased levels of time pressure [$F(2,38)=4.89$; $p<0.01$, see Fig. 5]. Nonetheless, the fitness level at which treatments were applied significantly declined over time pressure conditions [$F(2,38)=11.41$; $p<0.0001$].

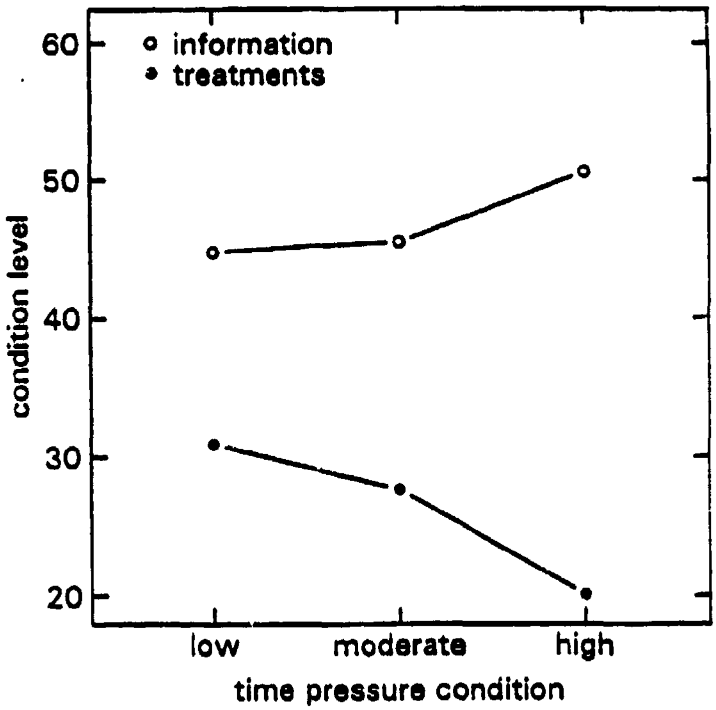

Fig. 5 Mean fitness level at which the subjects requested information and applied a treatment for each time pressure condition.

Furthermore, under increased levels of time pressure subjects speeded up information processing [F(2,38) = 10.25; p < 0.0001), see Table III]. These times are calculated by taking the difference between the time at which the relevant information appeared on the screen and the time at which the subject carried out an action. Faster processing did not affect the calculation of the treatment dosage, expressed by the relative deviation from the optimal dosage (all time pressure conditions: 0.15).

Table III Mean times (in seconds) that subjects needed to apply a treatment after the relevant information had appeared on the screen for each time pressure condition.

time pressure	low	moderate	high
mean treatment decision time	13.29	9.47	8.69

Subjects requested about the same amount of subjective as objective information. However, the proportions objective information requests did not change over

time pressure conditions [low time pressure: 0.48, moderate time pressure: 0.51, high time pressure: 0.56, $F(2,38)=2.1$; $p>0.1$].

Performance deteriorated under time pressure, as indicated by an increased number of athlete collapses under time pressure [$F(2,38)=5.09$; $p<0.01$, see Table IV]. The main reason for these collapses was that the subjects started too late with their information requests after the onset of a fitness declines. Under high time pressure 1 collapse occurred because of an incorrect treatment and 1 collapse occurred because subjective information was requested providing incorrect information on the underlying cause.

Table IV Proportion correct trials and proportion athlete collapses that were caused by reacting too late to fitness declines.

time pressure	low	moderate	high
proportion trials	0.97	0.87	0.76
too late	1.0	1.0	0.89

4 GENERAL DISCUSSION

The goal of the present experiments was to investigate time pressure effects on the selected strategy, processing speed and performance. Of particular interest was the extent to which subjects would adaptively react to time pressure, by switching from a strategy emphasizing minimum information costs under low time pressure to a strategy decreasing the chance on athlete collapse under high time pressure. As was shown in the introduction such a switch would provide a higher payoff compared to the employment of one particular strategy over all time pressure conditions.

The results showed that subjects in the second experiment started to request information at higher fitness levels indeed when time pressure increased. However, the extent to which the strategy is adaptive can only be judged in relation to the decision outcome, i.e. the subjects should select the strategy that provides the highest payoff given the time available (Payne, Bettman & Johnson, 1988). In the introduction we defined two strategies that either minimized information costs or the chance on athlete collapse. Applying these strategies to the second experiment shows that if subjects had minimized the chance on athlete collapse in the "high time pressure" condition and consistently had requested objective information whenever the fitness level decreased to a value of 75, 50 and 25, the expected payoff would have been: $0.11*2.00 + 0.11*1.50 +$

0.11*1.00 - 0.67*1.00 = -0,17. The actual mean payoff under high time pressure in the second experiment, however, was -Dfl. 1.18. Together with the significant increase in athlete collapses this result suggests that too much risks were taken under time pressure and the subjects would have been better off if they had started to request information at higher fitness levels.

However, the extent to which subjects learn to select an adaptive strategy, is dependent on the kind of feedback they receive (Creyer, Payne & Bettman, 1990). In both the practice trials and the experimental trials the subjects did not receive feedback on their payoff, and it could consequently not have been expected that they would learn to use a strategy maximizing their payoff. The reason for not giving this feedback relates to the research question of primary interest in the present study. We were interested in the influence of time-pressure on strategy selection in an ambiguous environment, given full knowledge of costs and benefits, rather than in the learning aspects of strategy selection. The ratio between "natural" declines and "physiological" declines were not exactly known by the subjects, the environment was ambiguous, providing a more realistic task environment (Einhorn & Hogarth, 1986).

Yet, the subjects had a rather extended practice session, allowing them to acquire some general knowledge of the task environment. It is reasonable to assume that they did learn that "natural" declines occurred more often than physiologically induced declines and that in case of a "natural" decline the fitness level of the athlete would restore between a fitness level of approximately 55 and 35. Furthermore, they will have gained a good sense of the risks involved in the various time pressure conditions. Therefore, since the exact parameters of the underlying model were not fully known to the subjects they could not use a global strategy, in order to optimize their profits. Thus, subjects may have waited until a fitness level of approximately 55 before starting to request information because they had learned that the a priori chance on a "natural" decline is higher than the a priori chance on a physiological cause. Even though such a strategy may be rational when only the local situation is considered, overall performance declined because too much risks were taken under increasing levels of time pressure.

Our second prediction concerning speed of information processing was supported by the results. In line with previous findings the results from both experiments showed an increase of information processing speed as time pressure increased (Ben Zur & Breznitz, 1981; Payne, Bettman & Johnson, 1988).

To summarize, the present results show that the subjects adapted to some extent to time-pressure by changing their strategy and speeding up information processing. However, even after controlling for time constraints performance was significantly worse under time pressure. It is suggested that time pressure interacted with the nature of the task: the exact relation between "natural" declines and physiological causes was not known to the subjects and feedback

was received by observing the fitness developments over time. This may well have caused the use of local strategies, focusing on different information sources over time, rather than the use of global strategies.

Uncertainty about probabilistic events and the availability of feedback are specific features of natural, dynamic task environments. Since such features may interact with decision behaviour under time pressure, generalisations from laboratory studies using different task environments should be made with care.

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Two experiments were conducted to investigate time pressure effects on both the selected decision strategy and the quality of task performance. A dynamic task environment was used. Subjects were required to monitor the continuously changing fitness level of an athlete, and to recover the athlete whenever fitness decline had a physiological cause. Time pressure was defined by the rate at which the fitness level changed over time. The major decision problem of the subjects was to trade-off the costs of requesting information against the increasing risk of a costly consequence. The experiments differed in the incentive scheme that was used: in the first experiment, the subjects increased their chance on a bonus by saving time, whereas in the second experiment they could directly save on money. Both experiments showed a speed-up of information processing as time pressure increased. In the first experiment subjects started to request information at the same fitness levels in all time pressure conditions, whereas in second experiment subjects started to request information at higher fitness levels when time pressure increased. However, in both experiments performance equally deteriorated under time pressure, as indicated by the number of athlete collapses. It is concluded that even though the subjects changed their strategy and increased their speed of information processing under time pressure, performance declined more than predicted by time constraints alone. This extra effect is ascribed to the characteristics of the task environment.

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